

XVI.—Notes on the Palæozoic Bivalved Entomostraca.—
No. XIX. On some Carboniferous Species of the Ostracodous Genus *Kirkbya*, Jones. By T. RUPERT JONES, F.R.S.,
and JAMES W. KIRKBY, Esq.

[Plate III.*]

THIS genus was established in 1859 for the reception of the species, *K. permiana*, Jones, from the Magnesian Limestone of Sunderland. The Carboniferous species, *K. Urei*, Jones, discovered by the Rev. David Ure near Rutherglen, about the year 1793, was at the same time recognized as belonging to this group†.

Previous to this, Professor M'Coy, in 1844, had described and figured, as *Cythere costata*, another and very characteristic member of the genus, from the Carboniferous Yellow Sandstone of Ireland‡.

In 1854, Prof. Dr. A. E. Reuss figured and described his *Kirkbya Reussleri* (as a *Cythere*) from the Lower Zechstein of Bleichenbach§; and in the same year Comnt Keyserling figured and described, as *Cythere Schrenkii*, *C. stricta*, and *C. grapta*, three *Kirkbyæ* from the Permian strata on the Pinéga in North-eastern Russia||.

Somewhat later, in 1860, M. E. d'Eichwald described and figured *Beyrichia umbonata* and *B. striolata*, two species which we refer to *Kirkbya*, from the Carboniferous Yellow Shale of Russia¶.

In 1867 nine species of *Kirkbya* were given in our List of Entomostraca occurring in the Carboniferous rocks of Scotland. Six of these were new**.

In 1869 one species, *K. fibula*, Jones and Holl, was described from the Silurian rocks of Malvern††.

Kirkbyæ are also referred to in Mr. Smith's list of Silurian Entomostraca (1881, Geol. Mag. dec. 2, vol. viii. p. 73), and in Mr. Vine's (1882, Quart. Journ. Geol. Soc. vol. xxxviii. p. 48).

* This Plate has been drawn with the aid of a grant from the Royal Society for the illustration of the fossil Bivalved Entomostraca.

† Trans. Tyneside Field-Club, vol. iv. p. 129.

‡ Syn. Char. Carb. Foss. Ireland, p. 165, pl. xxiii. fig. 11; Ann. & Mag. Nat. Hist. ser. 3, vol. xviii. 1866, p. 43.

§ Jahresb. Wetterau. Gesellsch. Naturk. Hanau, 1851-53, 1854, p. 70, pl. O. fig. 11 a, b.

|| In A. G. Schrenk's 'Reise nach dem Nordosten d. Europ. Russlands,' part 2 (8vo, Dorpat, 1854), p. 112, pl. 4. figs. 37-39.

¶ Lethæa Rossica, I. vii. p. 1347, pl. 52. fig. 10, & p. 1348, pl. 52. fig. 14; Ann. & Mag. Nat. Hist. ser. 4, vol. xv. 1875, pp. 53, 54.

** Trans. Geol. Soc. Glasgow, vol. ii. pp. 213-228, and vol. iii. Suppl. 1871, p. 28.

†† Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 224, pl. xv. fig. 9.

At various times the genus has been referred to incidentally, or in general terms, by one of us in papers on Palæozoic Bivalved Entomostraca—as in the *Proceed. Geologists' Assoc.* 1869, *Palæoz. Entom.* p. 8, and in the 'Monthly Microscopical Journal,' vol. iv. 1870, p. 192, where a generic description was given, and *K. Urei* figured (pl. 61. fig. 15) as a representative of it.

During the whole of this period, from 1859 to the present time, materials and information relating to *Kirkbya* have been accumulating with us; and of these ultimately we hope to make full use in our account of the Carboniferous Entomostraca for the Palæontographical Society. But in consideration of the genus having gradually become important as to the number of its species, as well as being a type of the Ostracoda especially distinctive of the Carboniferous period, we venture to offer, without more delay, the accompanying brief account of the more important (the majority) of the forms known to us.

Our knowledge of these forms is greatly due to the help we have obtained, in specimens, from numerous friends and correspondents. Among these may be named Mr. John Young, of the Hunterian Museum, Glasgow; Messrs. David Robertson, James Armstrong, James Thomson, and others of the same city; Mr. James Bennie, of the Geological Survey, Edinburgh; the late Mr. Charles Moore, of Bath, and others.

Most of our specimens of *Kirkbya* are from the marine shales overlying, underlying, or otherwise associated with the calcareous beds of the Carboniferous series. In Scotland they are equally common in the Upper and the Lower Limestone series; and some of the species are found in the thin limestones well down in the Calciferous Sandstones. In England they occur in the marine shales of the Yoredale rocks*, and in the shaly partings of the Scar or Mountain Limestone. The Irish specimens that we have seen are from the Lower Carboniferous Shales.

We have no examples of any of the species from the upper portion of the Carboniferous series, either Coal-measures or Millstone-grit, although in the Permian limestone, overlying the Coal-measures, in Durham and Yorkshire, one species (*K. permiana*) reappears, and ranges from the lowest beds to near the top of the formation.

In most cases the individuals of the different species occur rather sparingly, or but moderately plentiful, with the Brachiopods, Polyzoans, Crinoids, and other marine fossils usually associated with them. This is the rule; but in a few in-

* G. R. Vine, *Proceed. Yorksh. Geol. Polyt. Soc.* 1883, p. 239.

stances we have seen them numerous enough to be the prevailing fossils, and sometimes in such numbers as to be gregarious. *K. spiralis*, J. & K., offers the most notable example of this. In a thin, impure limestone of the Calciferous Sandstones, near Pittenweem, Fifeshire, it is found in great numbers; and, again, just as abundantly in a local intercalation of shale, in the Scar Limestone, at Meathop, Westmoreland. *K. costata* also appears to be about as plentiful in a Lower-Carboniferous deposit at Plashetts, Northumberland, if we may judge from the numbers of specimens that occur in a washing sent to us from that locality by our friend Mr. James Bennie. These instances, however, are exceptional in our experience.

The generic characters of *Kirkbya* were noticed in a former paper by one of us, as before mentioned (p. 175). They may be restated here concisely as follows:—

Carapace oblong, subovate, or ark-shaped; flatly convex or compressed. Valves usually thick-shelled, and generally higher behind than before; impressed with a subcentral pit, and ornamented with longitudinal or concentric wrinkles, riblets, ribs, or ridges, and often with surface-reticulation; the dorsal border is always straight; the ventral border is nearly straight, or slightly convex in its middle third, and boldly curved at the ends; and the extremities are more or less rounded, though somewhat angulate at their junction with the dorsal border; one end is generally more obliquely rounded than the other. The hingement is simple. The ventral edge of the dextral valve slightly overlaps that of the other.

The subcentral pit is sometimes above and sometimes below the median line of the valve, and it varies greatly in relative size; sometimes it is obsolete. In its typical form it is oval or nearly round; but in some species and varieties it becomes irregular in outline, and passes, by gradations, almost into the ordinary sulcus of *Beyrichia*.

In the Ann. & Mag. Nat. Hist. ser. 4, vol. iii. 1869, p. 225 a list of the then-known *Kirkbyæ* was given, and it was there remarked by one of us, concerning the so-called varieties, that “some, if not all, of these may be distinct species; for the soft parts may have varied more than the carapace.” The probability of this being really the case grows upon us, and we now regard the “varieties” *glypta*, *Rössleri*, *Schrenkii*, *sticta* (= *Richteriana* *), and *grapta* as species. (See also Ann. & Mag. Nat. Hist. for Nov. 1884, p. 340, footnote.)

* This is the same as the “*K. Rössleri*” described and figured by Dr. R. Richter, Zeitschr. deutsch. geol. Ges. vol. vii. 1855, p. 528, pl. 26. figs. 1–5.

List of Species and Varieties of *Kirkbya*.

	Permian.			Carboniferous.					
	Upper Magnes. Limest.	Middle Magnes. Limest.	Lower Magnes. Limest.	Coal-Measures.	Millstone-grit.	Carbonif. Limest. (Upper).	Carbonif. Limest. (Middle).	Carbonif. Limest. (Lower).	Calcif. Sandstone.
<i>Kirkbya permiana</i> , Jones	*	*	*	*	..	*	*
— <i>Schrenkii</i> (<i>Keyserling</i>)
— <i>sticta</i> (<i>Keys.</i>) [= <i>Richteriana</i> , Jones]
— <i>grapta</i> (<i>Keys.</i>)
— <i>Rössleri</i> (<i>Reuss</i>)
— <i>glypta</i> , Jones	*	*	*
— <i>umbonata</i> (<i>D'Eichwald</i>)
— —, var. <i>radiata</i> , Jones & <i>Kirkby</i>
— <i>oblonga</i> , J. & K.
— <i>annectens</i> , J. & K.	*
— —, var. <i>bipartita</i> , J. & K.
— <i>plicata</i> , J. & K.
— <i>spiralis</i> , J. & K.
— <i>spinosa</i> , J. & K.	*
— <i>costata</i> (<i>M'Coy</i>)	*
— —, var. <i>Mooreana</i> , J. & K.	*
— <i>scotica</i> , J. & K.	*
— <i>rigida</i> , J. & K.	*
— <i>Urei</i> , Jones	*
— <i>striolata</i> (<i>D'Eichwald</i>)	*
— <i>fibula</i> , Jones & <i>Holl</i>	*
— spp., <i>Smith & Vine</i> } Silurian.

K. umbonata, *permiana*, *spiralis*, and *costata* have been found in the Scar Limestone of the North-west of England, and *K. plicata* in the Carboniferous Limestone of the South-west of the same country. How far these rocks may be in part equivalent to the Calciferous Sandstone or Lower Carboniferous series of Scotch geology we are unable to say; but to some extent they undoubtedly are so (as already suggested by other writers), though we may probably have to go lower than the base of the Scar Limestone to find anything on the same horizon as the Lower Calciferous Sandstone beds of the South-east of Scotland.

1. *Kirkbya permiana*, Jones. (Pl. III. fig. 1.)

Dithyrocaris permiana, Jones, 1850, in King's 'Monograph of Permian Fossils' (Paleont. Soc.), p. 66, pl. 18. figs. 1a-d.

- Ceratiocaris*? *permiana*, Jones, in Morris's Catal. Brit. Foss. 1854, p. 103.
- Leporditia*? *permiana*, Kirkby, 1858, Ann. & Mag. Nat. Hist. ser. 3, vol. ii. p. 434, pl. xi. figs. 5-13.
- Kirkbya permiana*, Jones & Kirkby, 1859, Trans. Tyneside Field-Club, vol. iv. p. 129, pl. viii. A. figs. 1, 2, 3, and 5 (figs. 4 and 7, *K. glypta*), pl. x. figs. 5, 7, 9-12 (figs. 6 and 8 *K. glypta*).
- Kirkbya permiana*, Kirkby, 1861, Quart. Journ. Geol. Soc. vol. xvii. p. 308.
- Kirkbya permiana*, Jones & Kirkby, 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 28.
- Kirkbya permiana*, Armstrong and others, 1876, Catal. Western-Scottish Foss. p. 44.
- Kirkbya permiana*, J. & K. 1880, Quart. Journ. Geol. Soc. vol. xxxvi. p. 588.

This species, as a Permian "recurrent," was fully described in the 'Annals and Magazine of Natural History' for Nov. 1858; and again, in more detail, in the 'Transactions of the Tyneside Field-Club' for 1859. The descriptions and figures there given of Permian specimens from the Magnesian Limestone of Tunstall Hill would do equally well for most of the many Carboniferous examples of the species that have come under our notice; but, for convenience, we describe it from the latter as follows:—

Carapace ark-shaped or suboblong, flatly convex or compressed, height half the length or rather more. Dorsal border straight, sometimes the full length of the valve, sometimes rather less, according to the relative boldness of the curve of the extremities; ventral border faintly incurved, straight, or gently convex in its middle third, and boldly curved at the extremities, the anterior extremity being the most acute. The extremities and ventral portion of each valve are bordered by two parallel, concentric rims or expansions, which project a considerable distance beyond the surface of the valve. A small oval pit occupies a subcentral position on each valve, and the surface is beautifully reticulated. Length $\frac{1}{25}$ inch.

The Carboniferous specimens of this species vary considerably in character. The drawing here given (Pl. III. fig. 1) is that of an average good specimen; other illustrative figures would have been given had circumstances allowed.

The outline of the valves is usually as described above; but sometimes the extremities and ventral margin almost approximate the curve of a semicircle in the regularity of their contour; from this extreme the ends by degrees become more abruptly sloped, and the ventral border straightened, until an oblong figure is approached.

Many examples have the valves much depressed, others have them moderately convex (and so form a carapace of fair

capacity); and there are some few where the regularity of their surface is interfered with by one or more lobe-like swellings. In this feature it resembles *K. Schrenkii*, Keyserling*; but the latter has a rounded, and not ridged, ventral margin.

The ventral rims vary in development, and are apparently largest in old individuals. In some cases the mesh-walls on the reticulated surface show a tendency to run in faint riblets within and parallel to the marginal ridges.

The reticulation of the surface is relatively large, in most cases with a more or less angular form of mesh, and is very beautiful in well-preserved specimens.

The subcentral spot is often obsolete or not to be seen.

Kirkbya permiana is of common occurrence in the marine shales of the Carboniferous-Limestone series of Scotland and the north of England. It is found in a similar shale in the upper portion of the Calciferous Sandstone of Fife.

As a Permian species it is met with in the Magnesian Limestone of Durham and Yorkshire, also in Germany.

Some of its British localities are as follows:—

Scotland. Calciferous Sandstone: coast west of Pittenweem, Fife. Carboniferous Limestone (Lower): Brockley, Calderside Quarry, Brankumhall Quarry, in Lanarkshire; Galabraes, Whitebaults, in Linlithgowshire; Corrieburn, Scullengour, Craigenglen, in Stirlingshire; Fullerton, Curriellee Lime-works, Darcy Limestone Quarry, Magazine Lime-works, Hillhead Quarry, near Cockmuir Bridge, in Edinburghshire; Cateraig, near Dunbar, Burlage Quarry, East Salton, in East Lothian; coast near Abden, Glenniston Quarry, Inverteil Quarry, Ladedda Quarry, Wilkieson, Cults, Teasses, in Fife; Carlops, Whitefield, in Peebleshire. Carboniferous Limestone (Upper): Robroystone, Orehard, Kennox Water, Auchenbeg, in Lanarkshire; River Avon below Kinneil, in Linlithgowshire; &c.

England. Carboniferous-Limestone series: Scremerston, Ridsdale†, Ancroft, in Northumberland; Barnard Castle, Durham; Wyebourne, Calees, in Cumberland; in the Scar Limestone at Stainton Quarry, Lancashire.

As a "recurrent" in Permian strata it is found in the following localities:—

In Lower Magnesian Limestone: Westoe, Eldon, East Thickley, Walworth, Morton Timmouth, Summerhouse, and

* In Schrenk's 'Reise Nordost. Russl.' &c. 1854, p. 112, pl. 4. fig. 37.

† Mr. G. R. Vine quotes this species, also *K. umbonata* and *bipartita*, from Ridsdale, and from Hurst, Yorkshire (Proc. Yorksh. Geol. Polyt. Soc. for 1883, p. 237).

Langton, in Durham; railway-cutting at Chapel Houses (west of Pierce Bridge), Crakehall, Thornton Watlass, Nosterfield, and Hampole, in Yorkshire. In Middle Magnesian Limestone: Tunstall Hill, in Durham. In Upper Magnesian Limestone: Byer's Quarry, and cliffs to the south of Marsden, on the Durham coast.

2. *Kirkbya umbonata* (D'Eichwald), and var. *radiata*, nov.
(Plate III. fig. 2.)

Beyrichia umbonata, D'Eichwald, 1860, Lethæa Rossica, livr. vii. p. 1347, pl. lii. fig. 10.

Kirkbya umbonata, Jones & Kirkby, 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 221; and 1871, vol. iii. Suppl. p. 29.

Kirkbya umbonata, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Ark-shaped, with a central umbo and a wide ventral frill or marginal radiated expansion to each valve; height about half the length or more. Dorsal border straight; ventral border usually boldly curved; extremities rounded, the posterior being the larger and more obliquely curved than the other. The umbo is near the dorsal border, oval in shape, about a third of the valve's length and half its height in size; it is often awry or placed obliquely on the valve. There is a lamellar expansion or radiate frill round the ventral and extreme borders of each valve, which in older specimens has considerable development; these frills are plaited or ruffle-like, and have more or less scalloped edges. The surface is reticulated in some specimens, and in others finely papulose. Length $\frac{1}{25}$ inch.

This species is subject to some variation. Younger individuals more especially look different, owing to greater regularity of outline, the smaller size and pap-like form of the umbo, and the absence or meagre development of the frills. In the Russian specimen, described and figured by D'Eichwald, from the Yellow Carboniferous Shale of Sloboden, Government Toulá, the surface is said to be finely striated and pitted, the space between the umbo and the margin is raised into nearly regular concentric rolls or rounded ridges, and the frilling is absent, as in some of our specimens.

It is undoubtedly a near ally of *K. permiana*, with which it has much in common. It is usually, however, to be distinguished from the latter by its greater relative height, the more *Leperditia*-like truncation of the valves, by its irregular hump or umbo, and by the character of its ventral rims. The surface-reticulation also differs somewhat, not being so definitely meshed like network. The frill-less form occurs in Scotland

and in Westmoreland, and it has the umbo quite regular sometimes. The frill may be obsolete, or easily lost perhaps, as in the fringed *Beyrichie*.

K. umbonata occurs in the following localities:—

Scotland. Carboniferous Limestone (Lower): Brockley and Hairmyers, in Lanarkshire; Craigenglen, in Stirlingshire; Whitefield and Carlops, in Peeblesshire; Hillhead Quarry, near Cockmuir Bridge, in Edinburghshire; Kidlaw Quarry, Cateraig, Burlage Quarry, East Salton, in East Lothian; Wilkieson, Ladedda, Charleston, Cowdens Quarry, coast east of St. Monans, in Fifeshire.

England. Carboniferous-Limestone series: Scremerston, Barmoor Redhouse (Lowick), Ridsdale, in Northumberland; Calees, in Cumberland. In the Scar Limestone: at Arnside and in a railway-cutting near Heversham, Westmoreland.

3. *Kirkbya oblonga*, Jones & Kirkby. (Pl. III. fig. 3; and varieties, figs. 4, 5, and 6, *a*, *b*.)

Kirkbya oblonga, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 221; 1871, vol. iii. Suppl. p. 28.

Kirkbya oblonga, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 44.

Oblong-ovate, convex; height (which is uniform in the central third) equal to half the length or more. Dorsal border almost straight, but rather concave; ventral border usually straight in the central third; extremities boldly rounded and almost alike. In some cases the regular convexity of the valves is scarcely broken except by a slight medio-dorsal depression; in others this depression is more pronounced and the valves become rather humped towards the extremities; and in some specimens a circular boss appears in the centre. A slight rim bounds the free margins of the valves; in certain specimens a second is added, and occasionally the reticulation of the surface shows a tendency to develop itself into other less regular concentric wrinkles. Lateral contour subovate. Subcentral pit oval, often obscure. Surface covered with rather large hexagonal reticulation. Length $\frac{1}{30}$ – $\frac{1}{25}$ inch.

This species was discovered by our friend Mr. John Young, of Glasgow. It is a near ally of *K. permiana*; but, although the latter sometimes takes on a curved subcentral riblet (see Trans. Tyneside, 1859, pl. x. *a*. fig. 5 *a*), yet it never loses its marginal rims or its strong dorsal angles.

Localities.—*Scotland.* Carboniferous Limestone (Lower): Brockley, Lanarkshire; Craigenglen, Stirlingshire; coast east

of St. Monans, Fifeshire. Carboniferous Limestone (Upper) : near Kinneil Mill and Orchard Quarry.

Under this name (*K. oblonga*) we also place certain specimens that occurred to us first from the Carboniferous-Limestone series of Fife (figs. 4 and 6). The character of their reticulated surface, central pit, and ventral riblets sufficiently identify them with *Kirkbya*. We describe them thus:—

Varying from subreniform to suboblong and subquadrate in outline, often compressed; height two thirds of the length. Dorsal border straight for from about a third to a fourth less than the maximum length; ventral border curved or straight in central third; extremities rounded, the anterior being slightly the more acute. Surface reticulated (hexagonal or pentagonal meshes) and with two or more faint concentric riblets (including a slight marginal rim) below. Length $\frac{1}{27}$ inch. Edge view (lateral contour, fig. 6 *b*) is acute-oval.

Discovered by Mr. James Bennie in the Lower-Carboniferous Limestone, on the coast near Seafield Tower, Fifeshire.

Figs. 5 *a*, 5 *b*, represent a form that Mr. Robertson has from Williamswood, near Glasgow. It is relatively shorter than *K. permiana*, and the dorsal line is only about two thirds of the total length; it is thus nearly oblong, with rounded ends. The valves have each a slight marginal rim, are humpy towards the ends, or faintly lobed, and more coarsely reticulated than is usual with *K. permiana*; and there is a weak submedial riblet in some individuals. We figure it so as to keep it in view, as it is a form requiring further study. A somewhat similar short form, but more convex and more definitely ridged, we have seen in Mr. C. Moore's collection from Steeraway, Salop. Probably they are all closely allied to *K. oblonga*.

4. *Kirkbya annectens*, Jones & Kirkby. (Pl. III. figs. 7, *a-d*; and var. *bipartita*, figs. 8, *a, b*.)

Kirkbya annectens, J. & K., 1866, Ann. & Mag. Nat. Hist. ser. 3, vol. xviii. p. 42.

Kirkbya annectens, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; and *bipartita*, 1871, vol. iii. Suppl. p. 28.

Kirkbya annectens and *K. bipartita*, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 44.

Valves suboblong in outline, rather convex and lobed, height half the length or more. Dorsal border straight or slightly incurved, and about two thirds of the maximum length; ventral border either straight or slightly incurved, or as slightly convex; extremities rounded and in some specimens nearly alike, in others the anterior is the more acute.

The medio-dorsal portion of the valve is depressed, and in front is a rounded boss-like lobe, and behind is another lobe or tubercle, usually smaller than that in front; the ventral portion of the valve is swollen, and traversed longitudinally by a curved ridge or rib. Lateral contour subcuneiform. Shell rather thin. Surface smooth so far as known. Length $\frac{1}{30}$ inch. Edge view (figs. 7 *b*, *c*, and 8 *b*, lateral contours) compressed, ovate.

The above description applies more correctly to the Irish members of this species. Scotch examples show some differences; instead of two lobes or tubercles they sometimes have three, either all on the dorsal region of the valve or with the middle one rather lower down than those at the ends, and two (or at times three) strong ridges sweep across the valve concentrically with the extreme and ventral borders; the uppermost of these is occasionally fully above the median line of the valve, and the lowermost often takes the form of a marginal rim. The surface also, in some examples at least, is reticulated. It may be that these specimens represent a Scotch form specifically distinct from the others. This is a point for further investigation. For the present we designate it *K. annectens*, var. *bipartita*.

The Irish specimens we have seen were collected and submitted to our inspection by the late Sir Richard Griffiths. They are very uniform in character, all of them having the two bosses or tubercles, one towards each extremity of the valve, and but a single ventral rib. They have rather a Beyrichian look, and undoubtedly come nearer that genus than other members of the group under description.

Localities.—*Ireland.* In Lower-Limestone Shales, Drumard, Londonderry; Cultra, Down; Larganmore, Mayo.

Scotland. Carboniferous Limestone (Lower): Brockley, Lanarkshire; Orchard, Gare, in Lanarkshire; River Avon below Kinneil Mill, Linlithgowshire.

England. Hurst, near Richmond (*bipartita*), Yorkshire, on the authority of Mr. G. R. Vine (Proc. Yorksh. Geol. Polyt. Soc. 1883, p. 237).

Dr. C. W. Gümbel's *Kirkbya alpina*, figured in his 'Kurze Anleitung zu geol. Beobacht. in den Alpen,' 1878, p. 83, fig. 28, has a distant resemblance to *K. annectens*, but is much more like *Beyrichia arcuata* (Bean), as far as the little woodcut shows. It is from the Bellerophon-limestone, a passage-bed from the Palæozoic to the Mesozoic (between the Permian and the Trias).

5. *Kirkbya plicata*, Jones & Kirkby.(Pl. III. figs. 9 and 10, *a*, *b*.)*Kirkbya plicata*, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 221; 1871, vol. iii. Suppl. p. 28.*Kirkbya plicata*, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.*Kirkbya plicata*, Kirkby, 1880, Q. J. G. S. vol. xxxvi. p. 588.

Ovate to subovate, compressed, and considerably over half as high as long. Dorsal border straight, and two thirds (or more) of the maximum length; ventral border boldly arched; anterior extremity rounded and decidedly the smaller, sloping below; posterior extremity boldly and obliquely rounded. The subcentral pit is deep, transverse, and usually placed rather posteriorly. A narrow but prominent rim bounds the valves, and two sinuous ribs of equal size to the rim cross the valve from their point of junction near the antero-centre to near the hind margin or the postero-ventral angle, where they again approach very nearly together. These ribs divide the valve into dorsal, central, and ventral areas. The edge-view (lateral contour) varies in different specimens from flatly lenticular to subcuneiform (fig. 10, *b*). Surface smooth in most of our specimens, but in a few cases finely reticulated. Length $\frac{1}{2}$ inch.

Some few examples of this species show a third rib not far from the ventral border (fig. 9). The subcentral pit varies in size; sometimes it is not seen at all, and occasionally it takes more the form of a sulcus.

K. plicata was discovered by the late Mr. Charles Moore, of Bath, in the Carboniferous Limestone of Backwell, Somerset, where it appears to be not at all rare.

Localities.—*England.* Carboniferous Limestone: Backwell, Charterhouse, Weston-super-Mare, in Somerset.

Scotland. Calciferous Sandstone: Randerstone, Fife; Craiglockhart Quarry and Camps, in Edinburghshire; Larriston Quarry and Penton Bridge, in Roxburghshire. Carboniferous-Limestone series: Campbelltown, Argyleshire; Whitefield New Quarry, Peebleshire.

6. *Kirkbya spiralis*, Jones & Kirkby.(Pl. III. figs. 11, *a*, *b*.)*Kirkbya spiralis* (J. & K. MS.), Kirkby, Quart. Journ. Geol. Soc. vol. xxxvi. pp. 564, 568, 573, 588.*Kirkbya spiralis*, Jones, 1884, Proc. Berwicksh. Nat. Club, vol. x. p. 323, pl. ii. figs. 12, 13.

Carapace subovate or oblong, highest behind, compressed, slightly lobate; height half the length or more. Dorsal

border straight and about two thirds of the valve-length; ventral border incurved and sloping downwards to maximum height, which is in the posterior third; extremities rounded, the posterior being the larger and more projecting. The subcentral pit, which is transverse, is placed somewhat nearest the dorsal and posterior portions of the valve. A marginal rim bounds each valve, and is continued as a ridge from the dorsal centre downwards, and concentrically with the margins to or near the subcentral pit; within the central area thus formed is a longitudinal and somewhat sinuous ridge, which is free at the ends. Edge view (fig. 11, *b*, lateral contour) narrow, ovate, and rather constricted near the centre. Surface smooth. Length $\frac{1}{2}$ inch.

This species does not vary among individuals much in character, except perhaps a little in relative length.

It appears to be confined to the lower portion of the Carboniferous series, where it is very abundant at some horizons, as already noted (p. 176).

K. spiralis has been described by one of us in the 'Proceedings of the Berwickshire Naturalists' Club,' from somewhat imperfect specimens collected by the late Mr. George Tate, of Alnwick.

Localities.—*England.* Lower Carboniferous: Tweedmouth, Northumberland. Scar or Mountain Limestone: Meathop (near Grange-over-Sands), Westmoreland; Calcees, Cumberland.

Scotland. Calciferous Sandstone: on the coast near the following places:—east of Pittenweem, Billow Ness, Kilminning, Randerstone, and Kingsbarns, in Fifeshire; Oakbank Sandstone Quarry, Linlithgowshire.

7. *Kirkbya spinosa*, Jones & Kirkby. (Pl. III. figs. 12 *a, b*.)

Kirkbya spinosa, J. & K., 1867, Trans. Geol. Soc. of Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 29.

Kirkbya spinosa, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Ovate-oblong, oblique at the ends, swollen in front, rather compressed behind, less than twice as high as long. Dorsal border straight, and a fourth less than maximum length; ventral border curved; anterior extremity rounded and most prominent above; posterior extremity obliquely rounded and most prominent below. The anterior portion of the valve is much the thickest. The subcentral pit is sometimes longitudinal, sometimes transverse and almost a sulcus, which is occasionally divided by the upper ridge. Two, and even

three, ridges traverse the valve longitudinally, one either above or across the pit, the others below; the upper and mid ridges terminate in strong spines, which curve upward and forward. A very delicate rim bounds the free margins. Edge view (lateral contour) subcuneiform (fig. 12, *b*). Shell thin; surface smooth (?). Length $\frac{1}{5}$ inch.

In some specimens (probably old and worn) the ridges are almost obsolete; otherwise this species seems subject to little variation. Mr. James Thomson discovered this species.

Localities.—*England.* Carboniferous-Limestone series: Steeraway, Salop; Calces, Cumberland; Scremerston and Ridsdale, Northumberland; Holker Park, Lancashire.

Scotland. Carboniferous Limestone (Lower): Craigenglen, Scullengour, in Stirlingshire; Garpel Water, Ayrshire; Paiston Quarry, East Lothian. Carboniferous Limestone (Upper): Ravenscraig, Fifeshire.

8. *Kirkbya costata* (M'Coy). (Pl. III. figs. 13 *a, b*,
14 *a, b*; var. fig. 15.)

Cythere costata, M'Coy, 1844, Syn. Char. Carb. Foss. p. 165, pl. xxiii. fig. 11.

Kirkbya costata, J. & K., 1866, Ann. & Mag. Nat. Hist. ser. 3, xviii. p. 43.

Kirkbya costata, J., K., & B., 1884, Monogr. Brit. Foss. Biv. Entom. Pal. Soc. p. 89, pl. 7. fig. 17.

Subovate or ovate-oblong, flat-sided, rather highest behind, height more than half the length; thick-shelled, and strongly ribbed with subconcentric ridges. Dorsal border straight or nearly so, and over two thirds of the maximum length; ventral border more or less convex; extremities rounded, the anterior smaller than the other, and both somewhat angular above. Subcentral pit circular, rather above the median line, and showing internally as a raised spot. Edge view (lateral contour) long-ovate with flattened sides (fig. 13 *b*, 14 *b*). The extreme anterior portion of each valve is smooth, but from near the centre of that portion spring two strong ribs, one curving abruptly up and the other down, and then passing along the valves rather obliquely and sinuously to near the postero-ventral angle, where they curve to each other and join; between them are two or three somewhat smaller but similar ribs, also free at their anterior ends, but connected at the other. Other ribs come in below, more or less parallel to the lowest of those just described; and others come in above and fill up the triangular space between the upper large rib and the dorsal border, the highest being nearly as strong as the two first-mentioned. There is considerable variation in

the curvatures and connections of the riblets. Surface not reticulated so far as known. Length $\frac{1}{24}$ – $\frac{1}{20}$ inch.

The above description is taken from specimens which we identify with Prof. M'Coy's *Cythere costata*, but which do not exactly agree with the figures of the species in his 'Synopsis of the Characters of the Carboniferous Fossils of Ireland.' In all probability his specimens may not have been so perfect as ours; or the latter may possibly differ somewhat from the Irish examples. However this may be we think it well to assume that the highly costated species now described is the same as M'Coy's.

Localities.—*England.* Carboniferous-Limestone series: Steeraway, Salop; Weston-super-Mare, Somerset; Railway-cutting near Heversham, Westmoreland; Cam Beck, Cumberland; Plashetts, Northumberland.

Scotland. Carboniferous Limestone (Lower): Brockley, Lanarkshire; Cults Lime-works, Fifeshire.

8a. Var. *Mooreana*. (Pl. III. fig. 15.)

From Weston-super-Mare we have seen another costated *Kirkbya*, rather resembling the present species, but relatively much shorter and more subquadrate in outline, the height being two thirds of the length. The costation likewise is slightly different; and the subcentral pit takes more the form of a transverse slit. This may possibly be a distinct species; for the present we term it *K. costata*, var. *Mooreana*. It was collected by the late Mr. Charles Moore, of Bath.

9. *Kirkbya scotica*, Jones & Kirkby.

(Pl. III. figs. 16 & 17.)

Kirkbya scotica, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 28.

Kirkbya scotica, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Subrhomboidal, compressed, uniformly highest in the central third; height more than half the length. Dorsal border straight and over two thirds of the maximum length; ventral border slightly convex; extremities obliquely rounded, the posterior having the longest curve above, and the anterior below. Lateral contour (edge view) compressed-oblong. Subcentral pit roundish oval, and nearly in the centre of the valve in most cases. Valves covered with numerous (twelve or more) sinuous and inosculating ribs, somewhat concentric lengthwise and obliquely arranged. The ribs become less concentric and more parallel in some cases, as in fig. 17. Surface otherwise smooth, so far as known. Length $\frac{1}{35}$ inch.

This species, which was discovered by Mr. James Thomson,

of Glasgow, is allied to *K. costata*. It is about the smallest member of the genus; and it is rare, having as yet occurred only in two localities, both of which are north of the Border.

Localities.—*Scotland.* Carboniferous Limestone (Lower): Campbelltown, Argyleshire. Carboniferous Limestone (Upper): Linlithgow Bridge, Linlithgowshire.

10. *Kirkbya rigida*, Jones & Kirkby. (Pl. III. fig. 18.)

Beyrichia rigida, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 26.

Beyrichia rigida, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 43.

Elongate, nearly oblong, compressed, height half the length and less. Dorsal border straight, and not much less than the maximum length; ventral border more or less concave in most cases; extremities abruptly rounded and nearly alike, the anterior being slightly the smaller. The valves are very flat, and have two flanges or rims round the extreme and ventral borders; the inner one is usually the larger, projecting beyond the slight convexity of the carapace; the other, more truly marginal, is smaller. They are more or less sparsely denticulated in many specimens. Two narrow vermiform ridges descend from the dorsal border across half or two thirds of the valve, at about a third of the length of the valve from each extremity. Edge view (fig. 18, *b*, lateral contour) is elongately oblong, much compressed. Subcentral pit circular, small or obsolete. Surface reticulated, but very often more or less incrustated. Shell moderately thick. Length $\frac{1}{5}$ – $\frac{1}{30}$ inch.

This species varies in relative height and length, but is generally elongated, and much compressed at the sides. The anterior end is usually slightly the smaller, and the posterior is sometimes rather obliquely rounded, projecting most below. The two ribs are curious features, and, at first sight, might almost be looked upon as foreign bodies incrustated on the valves. As a rule, they are placed rather nearest to the anterior end; but they are not constant in position, and occasionally one of them is much stronger than the other. Seen from below, the carapace, with its ventral flanges, presents an elongated figure, four or five times as long as wide, with parallel or slightly concave sides, and abruptly truncate ends and attenuate corners (fig. 18, *b*), the ends being fully wider than the centre. In the dorsal view, the sides are decidedly concave and the ends much the widest part of the figure.

We formerly looked upon this species as referable to the genus *Beyrichia*; but the general outline of the carapace, its compressed sides, marginal ridges, reticulated surface, and subcentral pit lead us now to place it, without much hesitation, in *Kirkbya*, whilst its vertical ridges find an analogy in the median ridges of the next species.

It was discovered by Mr. John Young, of Glasgow, in the Carboniferous-Limestone series (Upper) of Orchard, near Thornliebank, Renfrewshire; and it also occurs in the same position at Kinneil Mill, Linlithgowshire.

11. *Kirkbya Urei*, Jones. (Pl. III. fig. 19.)

Kirkbya Urei, Jones, 1859, Trans. Tyneside Field-Club, vol. iv. p. 136.

Kirkbya Urei, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; and 1871, vol. iii. Suppl. p. 29.

Kirkbya Urei, Jones & Holl, 1869, Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 225.

Kirkbya Urei, Jones, 1870, Monthly Microscop. Journ. vol. iv. p. 185, pl. lxi. f. 15 a, b.

Kirkbya Urei, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Oblong, with ends rounded and nearly alike, and of equal height to the rest of the valve, height equal to two thirds of the length, strongly ribbed concentrically, thick-shelled. Dorsal border straight and four fifths of the maximum length; ventral border straight or very slightly concave, and sloping evenly up into the curvature of the extremities. There are three strong concentric ridges on each valve; the two outermost of which (speaking of the single valve) are marginal, and follow more exactly the contour of the valve, while the third forms, as it were, an escutcheon in the centre and is attached to the second, or inner one of the two marginal dorsal ridges; within the escutcheon is usually a more delicate, sharply bent ridge, U- or V-shaped, with the subcentral oval pit at its base. The surface is strongly reticulated, the meshes often being more or less rounded and irregular in size. Edge view (lateral contour) compressed ovate or suboblong, with the anterior end the narrower. Viewed from below, little is seen of the carapace but the four ventral ridges with intermediate reticulated spaces and the ridges of the escutcheon; the view from above (fig. 19, b) shows a broad obtusely angulated dorsal area, widest at the posterior end; along this area the two marginal ridges are continued (in less strength), single rows of meshes separating them from each other. Length $\frac{1}{5}$ – $\frac{1}{3}$ inch.

This is one of the smaller forms of the genus. Some specimens are relatively longer than others, and some have the extreme dorsal and ventral regions well rounded, and so are

more oval and less rectangular in figure than in perhaps more typical examples. The ridges vary in strength and sharpness, being sometimes very high and wall-like; the central concentric ridge, or escutcheon, as we have termed it, is occasionally imperfect ventrally. There are also other slight variations, as in all the *Kirkbyæ*; but, on the whole, this is a well-marked and characteristic species. It is of interest also on account of its having been discovered by the Rev. David Ure, of Rutherglen, in the Carboniferous-Limestone series of Western Scotland, so far back as 1793 or before. Specimens of it, along with other Microzoa, were sent by him to his friend Dr. John Hunter, in London, who placed them in his Museum, now the Hunterian Museum, Royal College of Surgeons, where they were noticed by one of us more than sixty years afterwards.

Localities.—*England.* Carboniferous-Limestone series: Dun Quarry near Lowick, Skellygate (Ridsdale), Scremerston, in Northumberland; Holker Park, Lancashire.

Scotland. Carboniferous Limestone (Lower): Brockley, High Blantyre, Head of Mouse Water, Capelrig Quarry, Brankumhall Quarry, and elsewhere in Lanarkshire; Craigenlen, Stirlingshire; Murrayfield Old Pit, Whitebaults Quarry, Linlithgowshire; Burlage Quarry, East Lothian; Darcy Limestone Quarry, Edinburghshire; Inverteil Quarry, Coast near Abden and Seafeld Tower, Wilkieston Quarry, Coast east of St. Monans, Sunnybank Quarry, Glenniston Quarry, in Fifeshire. Carboniferous Limestone (Upper): Robroystone.

Besides the foregoing species there are some other forms which additional material and further study may show to belong to *Kirkbya*. Certain of these forms (from the Lower Carboniferous beds) are rather perplexing in their double and almost equal relationship to *Beyrichia* and *Kirkbya*. To these we shall recur at some future opportunity.

NOTE.—In the Zeitschrift deutsch. geol. Gesellsch. 1867, Dr. R. Richter has figured and described *Kirkbya Richteriana* (p. 224, pl. v. figs. 1–3) and *K. collaris*, sp. nov. (p. 225, pl. v. figs. 5, 6), from the Zechstein of the neighbourhood of Saalfeld.

EXPLANATION OF PLATE III.

(The figures are all magnified 25 diameters.)

Fig. 1. *Kirkbya permiana*, Jones. Left valve. Carlops.

Fig. 2. *Kirkbya umbonata* (D'Eichwald), var. *radiata*. Right valve.

Fig. 3. *Kirkbya oblonga*, Jones and Kirkby. Right valve. Kinneil Mill.

- Fig. 4. *Kirkbya oblonga*, J. & K., var. Right valve. Near Seafield Tower.
- Fig. 5. *Kirkbya oblonga*, J. & K., var. *a*, left valve; *b*, ventral view. Williamswood.
- Fig. 6. *Kirkbya oblonga*, J. & K., var. *a*, left valve; *b*, ventral view. Orchard Quarry.
- Fig. 7. *Kirkbya annectens*, J. & K. *a*, left valve; *b*, ventral edge; *c*, dorsal edge; *d*, end view. Cultra.
- Fig. 8. *Kirkbya annectens*, var. *bipartita*, J. & K. *a*, right valve; *b*, edge view. Gare.
- Fig. 9. *Kirkbya plicata*, J. & K. Right valve. Weston-super-Mare.
- Fig. 10. *Kirkbya plicata*. *a*, left valve; *b*, edge view. Randerstone.
- Fig. 11. *Kirkbya spiralis*, J. & K. *a*, right valve; *b*, ventral view. Randerstone.
- Fig. 12. *Kirkbya spinosa*, J. & K. *a*, right valve; *b*, ventral view. Craigenglen.
- Fig. 13. *Kirkbya costata*, M. Coy. *a*, left valve; *b*, dorsal view. Cam Beck.
- Fig. 14. *Kirkbya costata*. *a*, left valve; *b*, ventral view. Steeraway.
- Fig. 15. *Kirkbya costata*, var. *Mooreana*, J. & K. Right valve. Weston-super-Mare.
- Fig. 16. *Kirkbya scotica*, J. & K. Right valve. Linlithgow Bridge.
- Fig. 17. *Kirkbya scotica*. Left valve. Campbelltown.
- Fig. 18. *Kirkbya rigida*, J. & K. *a*, left valve (?); *b*, ventral view. Kinneil Mill.
- Fig. 19. *Kirkbya Urci*, Jones. *a*, left valve; *b*, dorsal view. Burlage Quarry.

XVII.—*A List of Reptiles and Batrachians from the Province Rio Grande do Sul, Brazil, sent to the Natural-History Museum by Dr. H. von Ihering.* By G. A. BOULENGER.

IN the course of the last three years Dr. H. v. Ihering has transmitted to the Natural-History Museum numerous specimens of Reptiles and Batrachians collected by him in the province Rio Grande do Sul. The following list, which contains the names of all the species sent by Dr. v. Ihering, will be useful as completing our knowledge of the herpetological fauna of that district, which rested almost entirely upon the accounts published by Hensel in the 'Archiv für Naturgeschichte' for 1867 and 1868, and will also serve as a verification of some of that author's determinations. I have therefore indicated in synonymy the names given by Hensel whenever they differed from those employed by me; the species unknown to Hensel are preceded by an asterisk.

REPTILIA.

CHELONIA.

1. *Platemys Geoffroyana*, D. & B.